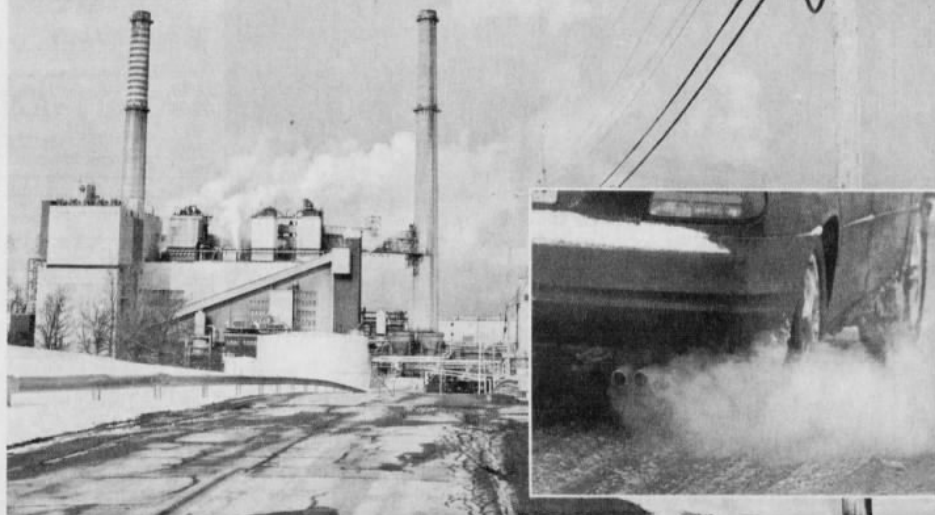


ROCHESTER'S AIR QUALITY IMPROVING



Kodak plant photo by ANNETTE LEIN staff photographer; car exhaust photo by MAX SCHULTE staff photographer

Most pollutant particles are produced by vehicle exhaust, inset, and emissions from coal-burning plants such as Kodak's Building 321. This view of the Kodak plant in Greece is looking north on Weiland Road from Ridgeway Avenue.

UR research focuses on effects of ultrafine particles

STEVE ORR
STAFF WRITER

Though the change probably isn't noticeable to most people, air quality in Rochester has improved markedly in recent years — and public health may well improve as a consequence.

Thanks to falling levels of key air pollutants given off by cars, trucks and power plants, the air contains far fewer of the irritants that might cause a scratchy nose in a healthy person, and definitely can worsen asthma in someone who suffers from that potentially serious respiratory disease.

No one has yet measured the impact of the cleaner air, but experts say improvement is surely there.

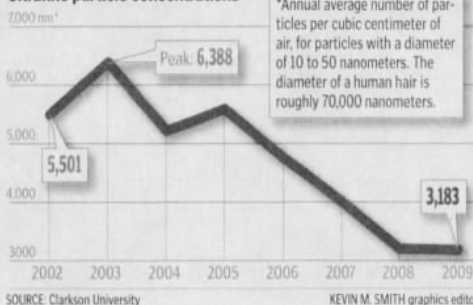
"The bottom line — cutting down on all these things has to lead to health benefits," said Dr. Douglas Jones, division director of allergy and rheumatology at Rochester General Hospital.

The decline in concentra-

Lungs breathe easier

Because of new diesel engine rules and power plant closings, the level of potentially dangerous ultrafine particles in Rochester's air has dropped by half since its 2003 peak.

Ultrafine particle concentrations



tions of the air pollutants — tiny particulates and sulfur dioxide gas, which come largely from vehicle exhaust pipes and power plant smokestacks — is documented in a new study by scientists at the University of Rochester Medical Center, or URM, and Clarkson University.

The study found that sulfur dioxide levels in local air dropped 53 percent between 2002 and 2009, the number of "fine" particles declined 43 percent and the number of "ultrafine" particles declined 37 percent. Sulfur dioxide and both kinds of particles can induce or exacerbate asthma, bronchitis and

other respiratory ailments. Particulates also can impair heart function, and their effect on people with pre-existing heart or lung disease can be fatal.

Scientists at URM, who have made Rochester one of the nation's top testbeds for the study of ultrafine particles, are exploring the extent to which these infinitesimally small pollutants migrate through tissue into the brain and blood, and the extent to which they damage the heart and other organs. About 30 percent of the local population suffers from allergies, and exposure to particles from diesel engine exhaust can push them into asthma, whose primary symptom is shortness of breath, Jones said. About 15 percent of Rochester-area residents suffer from that chronic disease, he said.

Concentrations of particles and sulfur dioxide tend

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Air

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to be higher near highways and downwind of coal-burning boilers, and rise and fall as traffic ebbs and flows, and as the sun rises and sets.

Two perceptible declines were noted in levels of the pollutants in local air. The first came after tighter federal rules on diesel fuel and engines went into effect in 2006. The second came after closure of several local coal-fired power plants; especially notable was the 2008 shuttering of the area's largest coal-burner, Rochester Gas and Electric Corp.'s Russell Station plant in Greece.

The Clarkson-URMC study, accepted for publication this spring, "will definitely draw lots of attention and make people be aware of the improvement of their air quality," said lead author Yungang Carl Wang, a doctoral student at Clarkson's Center for Air Resources Engineering and Science.

Most people have no idea these pollutants are present — ultra-fine particles, especially, are far too small to be seen with the naked eye, even when so concentrated that tens of thousands are present in an air parcel the size of a Kraft caramel.

But the falling concentrations of sulfur dioxide, fine particles and ultrafine particles almost surely will result in better overall public health.

"Fine particles in the atmosphere are readily inhaled and get down deep into the respiratory tract where they can cause a variety of health problems. An observed reduction in fine particles in Rochester is good news for the health of our community," said Dr. Andrew Doniger, the Monroe County health director. "So often, biological research has little immediate relevance to the health of communities. The authors should be commended for performing applied research that helps us understand how changes in our environment affect the health of the population."

The optimism is tempered, though, by the fact that even lower levels of particles in the air pose a health threat.

"There appears to be no threshold associated with particles. There are always going to be some people at risk, even with the lowest levels," said Dan Costa, national program director of air research for the U.S. Environmental Protection Agency, who is based in North Carolina. "Some individuals will be sensitive."

Then there is the one remaining coal-burning plant in Monroe County, located at Eastman Business Park in southern Greece. The Eastman Kodak Co. facility is thanks to a loophole in the regulations, the state's single biggest source of the sul-

fur dioxide gas that gives rise to ultrafine particles.

Growing evidence

In 1971, when the EPA first regulated particulate matter in the air, the agency focused as much on the visibility of pollutants belching from smokestacks as on health concerns. Seven years later, regulations were re-focused on particles smaller than 10 microns, or 10 millionths of a meter — small enough to be capable of making it into human airways.

Over time, researchers began to document striking health effects from inhalation of small particles, Costa said. "They measured a mortality signal with particulate matter that, if you projected it out nationwide, suggested there were potentially 60,000 people a year dying," he said.

In 1998, under pressure from interest groups, EPA enacted rules for particles smaller than 2.5 microns. The belief was that these particles were "the real bad actors," Costa said, able to penetrate the lungs when inhaled.

At the same time, Congress directed EPA to create five academic research centers to look into particulate pollution — and one of them was established at URMC.

The medical center's forte is ultrafine particles. Costa said the URMC particulate center director, Dr. Gunter Oberdorster, is considered "the father of ultrafine particles. He was working on them before they were sexy."

Ultrafine particles, or UFPs, are no larger than one-tenth of a micron. As Wang put it, if an ultrafine particle was as big as a watermelon, a watermelon would be as big as the planet Earth.

"While small, they're very reactive. They're certainly can get deep in the lung. Maybe these are the really bad actors," Costa said.

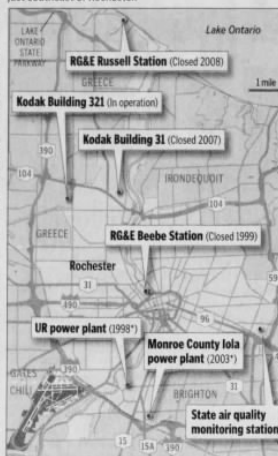
That, at least, is what the URMC scientists and their collaborators at Clarkson University are exploring.

Like other particles, UFPs can make pre-existing respiratory problems worse. But they can move beyond the respiratory tract.

"The ultrafines can get into the body tissue and the bloodstream. This happens in very small amounts. Whether that causes these health effects is not yet clear," said Dr. Mark Frampton, a pulmonologist at the medical center who leads human clinical studies at the URMC particulate research center. But research strongly suggests inhalation of ultrafine particles can have a range of health impacts. A study published last year by California scientists found UFPs caused inflammation in the lungs that exacerbated asthma. Frampton co-wrote a study published in December in the journal *Environmental Health Perspectives* that found that UFPs trigger changes in

Shutting down coal plants

Reduced coal burning in the Rochester area has led to improved air quality, measured by New York state at a site just southeast of Rochester.



SOURCE: Staff research. "Converted to gas." KEVIN M. SMITH graphics editor



Tom Everts, an environmental engineering technician, checks equipment at the air quality monitoring station near Blossom Road in Rochester last week.

people with diabetes that could increase their risk of heart problems.

And Frampton said URMC researchers plan to present preliminary findings in May from another clinical study showing "some associations" between UFP exposure and heart function.

"There's a growing body of evidence that exposure to ultrafine particles, just like exposure to larger particles, is harmful to the health," he said.

Generally, air quality in Rochester is considered good, said Thomas Marriott, who heads air pollution control for the state Department of Environmental Conservation, or DEC, in this region.

The only exception is ozone, the primary component of the respiratory irritant known as smog. The Rochester area, like much of upstate New York, is listed as not in compliance with EPA standards for ozone. The concentration of ozone, which is formed when sunlight interacts with air pollutants from both local and distant sources, occasionally reaches the point on hot summer days where alerts are issued to warn susceptible people to curb strenuous activities.

Concentrations of sulfur dioxide and fine particles — known in government-speak as PM 2.5 — also can spike to undesirable levels on occasion,

though both are far below EPA annual average standards.

There are no air-quality standards that apply specifically to UFPs, and most monitoring for them is of limited duration for research purposes. For that reason, it's difficult to say how concentrations here compare to other cities.

Wang said, however, that the average concentration of UFPs measured in Rochester between 2002 and 2009 was "much lower" than comparable levels found in other locations where research has been done. For instance, studies in Pittsburgh and Copenhagen, Denmark, somewhat comparable to the work here, found concentrations about three times higher than Rochester. Sampling in New Delhi, India, measured levels six times higher than Rochester. Levels in Corpus Christi, Texas, once were measured at nine times the average here.

"Air quality in Rochester is cleaner than many locations, but there is still exposure to ultrafine particles," Wang said.

It is not clear when or whether any standards will be written for ultrafines. Costa said there is "overwhelming" evidence that particles smaller than 2.5 microns are related to increased mortality and health problems. But how many of those problems are caused by the portion

of those particles that fall into the ultrafine category is not yet clear.

"That's the enigma right now," Costa said.

Study unprecedented

Clarkson and URMC scientists have been sampling the air here for ultrafine particles for more than nine years. They have equipment at a state air monitoring station on the city's east side, and once deployed a mobile monitoring unit as well.

The level of study here is unprecedented. "There are no long-term UFP monitoring programs in the U.S. except the one in Rochester," Wang said. "It provides the longest time record of ambient UFP data across the country."

The Clarkson-URMC study, to be published in the journal *Atmospheric Environment*, documented the "significant impact" on air quality of vehicle traffic and coal-burning plants.

In terms of ultrafine particles, Wang said the largest share, 42 percent, came from car and truck exhaust. Coal combustion generated 23 percent, and 22 percent were particles created in the air by a chemical reaction that starts with sulfur dioxide. Power plants are one source of sulfur dioxide, as are vehicle emissions, though Wang said the relative contribution of each in the local air is still being analyzed.

The study also found clear evidence of why particle and sulfur dioxide levels fell so abruptly.

First were changes in diesel-engine emissions. Though gasoline-powered cars far outnumber diesel-powered trucks, buses, tractors and other heavy equipment, the latter are proportionately more polluting. "As a metaphor, look at the exhaust pipes. They're 6 inches wide on a diesel truck, 1½ inches wide on a car," said Steve Flint, assistant director of air resources at the state DEC Albany.

New federal regulations that were fully in place by October 2006, however, reduced the sulfur content of diesel fuel by 97 percent. The following year, tougher emission standards on new diesel engines became effective and are further reducing particulate and sulfur dioxide emissions as new trucks come on the road.

"Certainly, the changes in diesel ... are huge as far as getting improved air quality," Flint said.

At the same time, large local coal-burning plants were shutting down. Facilities at the University of Rochester and Monroe County had converted to natural gas years earlier, and RG&E's Beebe Station at High Falls had closed in 1999. Then in late 2007 one of two coal-burning generating stations at the former Kodak Park was decommissioned, followed by Russell Station.

Wang said this led to a "distinct decline" in ultrafine particles from coal combustion, and to a drop in sulfur dioxide and the slightly different particles that it forms in the atmosphere.

Last local coal plant

That left Building 321 at Eastman Business Park,

just west of Mt. Read Boulevard, as the only remaining coal-fired plant in the area.

Two decades ago, Kodak was in the public eye because of large-scale atmospheric releases of toxic solvents. Since that time, Kodak has slashed toxic releases to air and water by 89 percent, and reduced solvent releases by an even greater percentage.

Today, the large majority of Kodak's releases to the air are related to Building 321. The plant is the state's second-leading emitter of toxic air compounds that come from burning coal, and is New York's single largest source of sulfur dioxide, according to state and federal data.

A plot of sulfur dioxide levels in 2007 included in the Clarkson-URMC study showed the highest average levels in the northern part of the county, where Russell Station and Kodak's plants are located. A plot of 2009 levels, after Russell had closed, showed the highest values emanating directly from Eastman Business Park.

The plant, which also generates steam for heating, cooling and industrial uses, can produce up to 130 megawatts of electricity — enough to meet the needs of roughly 90,000 average Rochester-area households. But none of Building 321's electricity makes its way to homes — it's reserved solely for use by Kodak and other companies at the business park.

Because Building 321 is classified as an industrial facility, not a utility power plant, several layers of new air-quality regulations in the 2000s did not apply to the Kodak plant, said Rob Sliwinski, director of the DEC's Bureau of Air Quality Planning. The regulations, as well as an enforcement crackdown, were aimed at utility power plants.

As a consequence, officials have not required Kodak to install scrubbers or advanced post-combustion controls designed to minimize sulfur dioxide and other emissions.

Kodak spokesman Christopher Veronda said the company has greatly reduced coal-related emissions, partly as a result of less business activity at the park and partly because of an aggressive energy-conservation campaign that has earned EPA awards. The amount of coal burned at the business park has fallen 41 percent since 2005. The company also has invested millions in pollution control technology at the power plant, he said.

Sliwinski said regulations that take effect in three years will drive further emission reductions at Building 321. The company has proposed installing equipment to control nitrogen oxide releases and will reduce sulfur dioxide emissions as well, though the means and degree of reduction remains unclear.

"We're always committed to compliance with federal and state standards, and we work very closely ... with the regulators," Veronda said. □

SOURCE: Democrat and Chronicle